

CLAIMS

1. A common mode noise filter comprising:

a first insulating layer having a top surface and a bottom surface,
the first insulating layer being made of magnetic material;

5 a first conductor provided on the top surface of the first insulating
layer;

a second insulating layer having a top surface and a bottom
surface, the bottom surface of the second insulating layer being located on
the first conductor, the second insulating layer being made of nonmagnetic
10 material;

a second conductor having a spiral shape provided on the top
surface of the second insulating layer, the second conductor having a first
end and a second end, the second end of the second conductor being
connected with the first conductor, the first conductor and the second
15 conductor providing a first coil;

a third insulating layer having a top surface and a bottom surface,
the bottom surface of the third insulating layer being located on the second
conductor, the third insulating layer being made of nonmagnetic material;

a third conductor having a spiral shape provided on the top
20 surface of the third insulating layer, the third conductor having a first end
and a second end, the third conductor facing the second conductor across the
third insulating layer;

a fourth insulating layer having a top surface and a bottom
surface, the bottom surface of the fourth insulating layer being located on the
25 third conductor, the fourth insulating layer being made of nonmagnetic
material;

a fourth conductor connected with the second end of the third

conductor, the third conductor and the fourth conductor providing a second coil;

a fifth insulating layer provided on the top surface of the fourth conductor, the fifth insulating layer being made of magnetic material;

5 a first lead electrode connected with the first conductor;

a second lead electrode connected with the first end of the second conductor;

a third lead electrode connected with the first end of the third conductor; and

10 a fourth lead electrode connected with the fourth conductor,

wherein the third insulating layer is thicker than the second insulating layer and the fourth insulating layer.

2. The common mode noise filter of claim 1, wherein the fourth
15 conductor is provided on the top surface of the fourth insulating layer.

3. The common mode noise filter of claim 1, wherein the third
insulating layer has a thickness not less than 20 μ m, and the second
insulating layer and the fourth insulating layer have thicknesses not more
20 than 20 μ m.

4. The common mode noise filter of claim 1, further comprising a
magnetic portion made of magnetic material at the third insulating layer,
the magnetic portion being located inside the spiral shape of the second
25 conductor and the spiral shape of the third conductor.

5. The common mode noise filter of claim 1, further comprising a

plurality of magnetic portions made of magnetic material at the third insulating layer, the magnetic portions being located inside the spiral shape of the second conductor and the spiral shape of the third conductor.

5 6. The common mode noise filter of claim 1,
 wherein the fourth conductor is provided on the top surface of the
first insulating layer,
 wherein the first insulating layer has a side, and
 wherein the first lead electrode and the fourth lead electrode
10 expose to the side of the first insulating layer.

 7. The common mode noise filter of claim 1, wherein the first to fourth
lead electrodes have widths larger than widths of the first to fourth
conductors.

15 8. The common mode noise filter of claim 1, wherein the first
conductor and the fourth conductor have widths larger than widths of the
second conductor and the third conductor.

20 9. A common mode noise filter comprising:
 a first insulating layer having a top surface and a bottom surface,
the first insulating layer being made of magnetic material;
 a first conductor provided on the top surface of the first insulating
layer;
25 a second insulating layer having a top surface and a bottom
surface, the bottom surface of the second insulating layer being located on
the first conductor, the second insulating layer being made of nonmagnetic

material;

a second conductor having a spiral shape provided on the top surface of the second insulating layer, the second conductor having a first end and a second end, the second end of the second conductor being
5 connected with the first conductor, the first conductor and the second conductor providing a first coil;

a third insulating layer having a top surface and a bottom surface, the bottom surface of the third insulating layer being located on the second conductor, the third insulating layer being made of nonmagnetic material;

10 a third conductor having a spiral shape provided on the top surface of the third insulating layer, the third conductor having a first end and a second end, the third conductor facing the second conductor across the third insulating layer;

a fourth insulating layer having a top surface and a bottom
15 surface, the bottom surface of the fourth insulating layer being located on the third conductor, the fourth insulating layer being made of nonmagnetic material;

a fourth conductor connected with the second end of the third conductor, the third conductor and the fourth conductor providing a second
20 coil;

a fifth insulating layer provided on the top surface of the fourth conductor, the fifth insulating layer being made of magnetic material;

a plurality of magnetic portions made of magnetic material provided at the third insulating layer, the plurality of magnetic portions
25 being located inside the spiral shape of the second conductor and the spiral shape of the third conductor;

a first lead electrode connected with the first conductor;

a second lead electrode connected with the first end of the second conductor;

a third lead electrode connected with the first end of the third conductor; and

5 a fourth lead electrode connected with the fourth conductor.

10 10. The common mode noise filter of claim 9, wherein the fourth conductor is provided on the top surface of the fourth insulating layer.

10 11. The common mode noise filter of claim 9, wherein the third insulating layer has a thickness not less than 20 μ m, and the second insulating layer and the fourth insulating layer have thicknesses not more than 20 μ m.

15 12. The common mode noise filter of claim 9, wherein the fourth conductor is provided on the top surface of the first insulating layer,

wherein the first insulating layer has a side, and

20 wherein the first lead electrode and the fourth lead electrode exposed to the side of the first insulating layer.

13. The common mode noise filter of claim 9, wherein the first to fourth lead electrodes have widths larger than widths of the first to fourth conductors.

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14. The common mode noise filter of claim 9, wherein the first conductor and the fourth conductor have widths larger than widths of the

second conductor and the third conductor.

15. A common mode noise filter comprising:

a first insulating layer having a top surface and a bottom surface,

5 the first insulating layer being made of magnetic material;

a first conductor provided on the top surface of the first insulating layer;

a second insulating layer having a top surface and a bottom surface, the bottom surface of the second insulating layer being located on
10 the first conductor, the second insulating layer being made of nonmagnetic material, the second insulating layer having a thickness not more than 20 μ m;

a second conductor having a spiral shape provided on the top surface of the second insulating layer, the second conductor having a first
15 end and a second end, the second end of the second conductor being connected with the first conductor, the first conductor and the second conductor providing a first coil;

a third insulating layer having a top surface and a bottom surface, the second surface of the third insulating layer being located on the second
20 conductor, the third insulating layer being made of nonmagnetic material;

a third conductor having a spiral shape provided on the top surface of the third insulating layer, the third conductor having a first end and a second end, the third conductor facing the second conductor across the third insulating layer;

25 a fourth insulating layer having a top surface and a bottom surface, the bottom surface of the fourth insulating layer being located on the third conductor, the fourth insulating layer being made of nonmagnetic

material, the fourth insulating layer having a thickness not more than 20 μ m;

a fourth conductor connected with the second end of the third conductor, the third conductor and the fourth conductor providing a second coil;

a fifth insulating layer provided on the top surface of the fourth conductor, the fifth insulating layer being made of magnetic material;

a magnetic portion made of magnetic material provided at the third insulating layer, the magnetic portion being located inside the spiral shape of the second conductor and the spiral shape of the third conductor;

a first lead electrode connected with the first conductor;

a second lead electrode connected with the first end of the second conductor;

a third lead electrode connected with the first end of the third conductor; and

a fourth lead electrode connected with the fourth conductor.

16. The common mode noise filter of claim 15, wherein the third insulating layer is thicker than the second insulating layer and the fourth insulating layer.